

PATENT APPLICATION TRANSMITTAL LETTER  
(Large Entity)

Docket No.  
1047

TO THE ASSISTANT COMMISSIONER FOR PATENTS

Transmitted herewith for filing under 35 U.S.C. 111 and 37 C.F.R. 1.53 is the patent application of:

LUCAS, B. ET AL

For: CIRCUIT DEVICE WITH A CONTACT ELEMENT FOR ELECTRICALLY CONNECTING A WAVE GUIDE  
IN A NEARLY STRESS-FREE MANNER

Enclosed are:

- ☒ Certificate of Mailing with Express Mail Mailing Label No. EK069304443  
☒ 2 sheets of drawings.  
☐ A certified copy of a application.  
☒ Declaration ☐ Signed. ☒ Unsigned.  
☒ Power of Attorney  
☒ Information Disclosure Statement  
☐ Preliminary Amendment  
☐ Other:

CLAIMS AS FILED

For	#Filed	#Allowed	#Extra	Rate	Fee
Total Claims	9	- 20 =	0	x \$22.00	\$0.00
Indep. Claims	1	- 3 =	0	x \$82.00	\$0.00
Multiple Dependent Claims (check if applicable) <input type="checkbox"/>					\$0.00
BASIC FEE					\$690.00
TOTAL FILING FEE					\$690.00

- ☐ A check in the amount of to cover the filing fee is enclosed.  
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☐ Charge the issue fee set in 37 C.F.R. 1.18 at the mailing of the Notice of Allowance,  
pursuant to 37 C.F.R. 1.311(b).

Dated: JANUARY 20, 2000

  
Signature

MICHAEL J. STRIKER

cc:

**BE IT KNOWN** that **WE**, Bernhard LUCAS, Frank SCHATZ, Juergen SEIZ, Heinz EISENSCHMID, Andreas KUGLER and Achim DIETERICH, citizens of Germany, whose post office addresses and residencies are, respectively, Zehenderstrasse 2, 74354 Besigheim, Germany; Tellstrasse 29, 70806 Kornwestheim, Germany; Baumbluete 11, 73642 Welzheim, Germany; Ludwigshafener Strasse 7, 70499 Stuttgart, Germany; Teckstrasse 13, 73553 Alfdorf, Germany; and Spielhof 25, 71540 Murrhardt, Germany; have invented a certain new and useful

10      **CIRCUIT DEVICE WITH A CONTACT ELEMENT FOR ELECTRICALLY  
CONNECTING A WAVE GUIDE AND A CONDUCTOR STRIP  
IN A NEARLY STRESS-FREE MANNER**

of which the following is a complete specification thereof:

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

5           The present invention relates to a circuit device with a contact element for electrically connecting a wave guide to a conductor strip.

### 2. Prior Art

10           A so-called stepping transformer, whose geometry is substantially determined by the wavelength of the frequencies used, is employed in high frequency circuitry in a frequency range over 50 GHz at the junction between a wave guide and conductor strip circuit elements.

          Usually an electrical connection of the final stage of the stepping  
15           transformer to the conductor strip circuit device is required. This electrical connection is, for example, accomplished by glued conducting small gold bands. These small gold bands are either mounted over a corner or on the bottom side of the final stage. This fabrication method is very expensive. Furthermore the electrical connection is put under great mechanical stress by possible relative  
20           motion due to differing thermal expansion of the metallic wave guide and the dielectric conductor strip substrates.

## Summary of the Invention

It is an object of the present invention to provide a circuit device with a  
5 contact element for electrically connecting the wave guide to a conductor strip,  
which does not have the above-mentioned disadvantage.

According to the invention the contact element electrically connects the  
wave guide with the conductor strip by means of two contacting areas and is  
made from an accurately prefabricated coil spring having predetermined  
10 reproducible properties. This coil spring is connected at one of the contacting  
areas to the conductor strip or to the wave guide by means of an electrically  
conductive glue and another of the contacting areas is a sliding contact whereby  
the coil spring is pre-tensioned; or is provided by an electrically conductive glue  
or adhesive portion, whereby the coil spring is bent into a U-shape; or is provided  
15 with a highly flexible electrically conductive adhesive section.

This type of electrical connection is easy to make. Different thermal  
expansion properties of the different materials are easily and satisfactorily  
compensated.

Advantageous additional embodiments are set forth in the dependent  
20 claims. Their features, in so far as it is appropriate and significant, may of course  
be combined with each other.

The sliding contact can move with the participating structural elements  
without experiencing significant mechanical stresses due to relative motions

(originating , for example, from differing thermal expansion properties). Without the device according to the invention the contacting areas would be subjected to impermissibly large mechanical stresses. The motion is compensated by the coil spring itself and/or by the pre-tensioned sliding contact in a nearly stress-free manner.

Relative motion of the parts occurs without tearing off the contact element. The contact junction is reproducible and not dependent on the bonding form and processes. Thus the electrical tuning between the wave guide and the conductor strip is reproducible.

The coil spring for applications in the highest frequency engineering is especially small (length, about 100 to 200  $\mu\text{m}$ , thickness about 50  $\mu\text{m}$ ). The coil spring is formed with very great accuracy, particularly as a so-called MIGA coil spring(MIGA = microgalvanic). UV depth lithography or comparable methods of structuring polymers in combination with multilayer microgalvanic methods are suitable for making the coil spring. Laser processing or high precision punching or stamping can be suitable for making the coil spring.

Thus simple but precise or exact fabrication methods are possible for the coil spring. Tolerances of  $< \pm 10 \mu\text{m}$  may be obtained for the above-described contact element with UV depth lithography. A wide range of materials can be selected so that special spring properties can be obtained. An automatic mounting of the coil spring and easy manufacture of the electrical connection are possible. Several coil springs can be economically made at the same time in a batch process (which means for many applications).

## Brief Description of the Drawing

The objects, features and advantages of the invention will now be  
5 illustrated in more detail with the aid of the following description of the preferred  
embodiments, with reference to the accompanying figures in which:

Figure 1 is a schematic cutaway cross-sectional view through a first  
embodiment of a circuit device with a contact element for connecting a wave  
guide to a conductor strip;

10 Figure 2 is a schematic cutaway cross-sectional view through a second  
embodiment of a circuit device with a contact element for connecting a wave  
guide to a conductor strip;

Figure 3 is a schematic cutaway cross-sectional view through a third  
embodiment of a circuit device with a contact element for connecting a wave  
15 guide to a conductor strip;

Figure 4 is a schematic cutaway cross-sectional view through a fourth  
embodiment of a circuit device with a contact element for connecting a wave  
guide to a conductor strip; and

Figure 5 is a schematic cutaway cross-sectional view through a fifth  
20 embodiment of a circuit device with a contact element for connecting a wave  
guide to a conductor strip.

## Description of the Preferred Embodiments

A wave guide 1 in the form of a stepping transformer and a conductor strip  
5 substrate 2 rest on a metal plate 5. The wave guide is screwed on the metal  
plate 5. The form of the stepping transformer is not described here in detail. The  
conductor strip substrate 2 is glued on with the help of an electrically conductive  
adhesive material or glue 6. The conductor strip substrate 2 is provided on its  
upper side with a conductor strip 7. This conductor strip is a component of a  
10 microwave IC (MIC). The wave guide 1 has a coupling opening 8 in the vicinity of  
the conductor strip.

According to figure 1 a coil spring 11 operating as an electrically  
conductive contact element is bonded to the conductor strip 7 at a first contacting  
area 9 with an electrically conducting glue or adhesive . Silver-filled epoxy resin  
15 glue is suitable as the adhesive material. The wave guide 1 is assembled after  
the coil spring 11 has been bonded with the adhesive, so that the mechanically  
pre-tensioned coil spring 11, which forms a sliding contact 10 at a second  
contacting area 9', presses resiliently against a surface 1a of the wave guide 1,  
which extends substantially perpendicularly to the plane of the conductor strip 7.  
20 The contact element forms a low impedance contact between the wave guide 1  
and the conductor strip 7. This low impedance connection is required in order to  
permit an optimum tuning of the coupling of the electromagnetic waves from the

wave guide 1 into the conductor strip 7. Besides the geometry of the junction plays an important roll.

Relative motions, especially thermally dependent relative motions, between the wave guide 1 and the conductor strip 7 are compensated with the help of the sliding contact 10 and the spring force of the coil spring 11. Without this device the contacting areas would be subjected to impermissibly large mechanical stresses.

Figure 2 illustrates another embodiment for the coil spring 12. This embodiment is similar to the embodiment shown in Fig. 1, but differs from it because the surface 1b of the wave guide 1 on which the coil spring 12 bears is substantially parallel to the conductor strip 7.

This latter situation in regard to Fig. 2 is also true of the third embodiment shown in Fig. 3. In the embodiment shown in Fig. 3 a sliding contact 10 of a coil spring 13 is located in a cavity 1c of the wave guide 1. It is also possible to additionally secure the spring contact in the cavity with a highly flexible electrically conductive glue or adhesive material.

In the embodiment shown in Fig. 4 a coil spring 14 is electrically conductively glued to the wave guide 1, while the sliding contact 10 makes electrical contact on the conductor strip 7 on the other conducting area 9'.

In Figure 5 in a fifth embodiment the coil spring 15 has a curved U-shape. The coil spring 15 is glued in an electrically conductive manner to a first contacting area 9 on the conductor strip 7. The other contacting area 9' of the coil spring 15 is formed as an electrically conducting adhesive area 16. This adhesive



area 16 can however be highly flexible. The coil spring 15 needed not then be formed so that it is U-shaped.

The disclosure in German Patent Application 199 02 240.2 of January 21, 1999 is incorporated here by reference. This German Patent Application  
5 describes the invention described hereinabove and claimed in the claims appended hereinbelow and provides the basis for a claim of priority for the instant invention under 35 U.S.C. 119.

While the invention has been illustrated and described as embodied in a circuit device with a contact element for electrically connecting a wave guide and  
10 a conductor strip in a nearly stress-free manner, it is not intended to be limited to the details shown, since various modifications and changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it  
15 for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed is new and is set forth in the following appended claims.

**We claim:**

- 1 1. A circuit device with a contact element that electrically connects a wave guide  
2 (1) with a conductor strip (7) by means of two contacting areas (9,9'),  
3 wherein the contact element consists of a prefabricated coil spring (11 to  
4 15) having reproducible spring properties, is bonded at one (9) of the contacting  
5 areas to the wave guide (1) or the conductor strip (7) by means of an electrically  
6 conductive glue or adhesive, and  
7 wherein another (9') of the contacting areas is a sliding contact (10),  
8 whereby the coil spring is pre-tensioned; or is provided by an electrically  
9 conductive glue or adhesive portion (16), whereby the coil spring (15) is bent into  
10 a U-shape; or is provided with a highly flexible electrically conductive adhesive  
11 section (16).  
  
1 2. The circuit device as defined in claim 1, wherein said coil spring (11 to 15) is  
2 made by means of UV depth lithography and multilayer galvanic methods.  
  
1 3. The circuit device as defined in claim 1, wherein said coil spring (11 to 15) is  
2 made by laser processing.  
  
1 4. The circuit device as defined in claim 1, wherein said coil spring (11 to 15) is  
2 made by high precision stamping or punching.

1 5. The circuit device as defined in claim 1, wherein said coil spring (11 to 15) is  
2 made by means of a batch process.

1 6. The circuit device as defined in claim 1, wherein said wave guide is a stepping  
2 transformer.

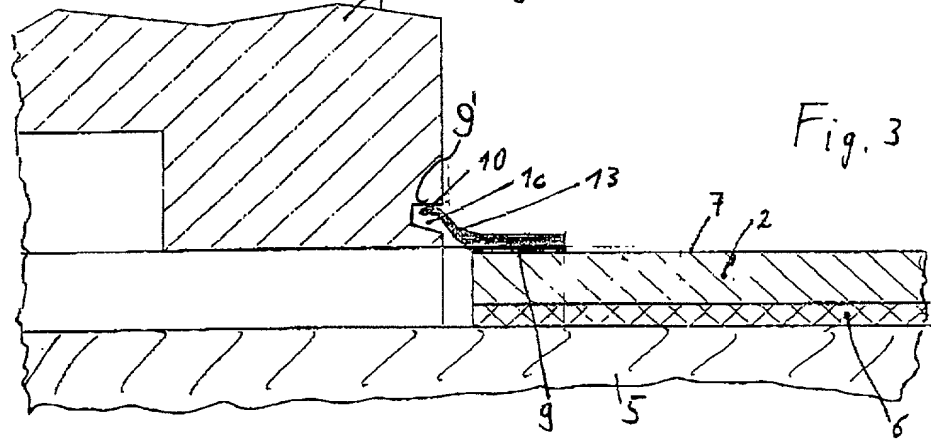
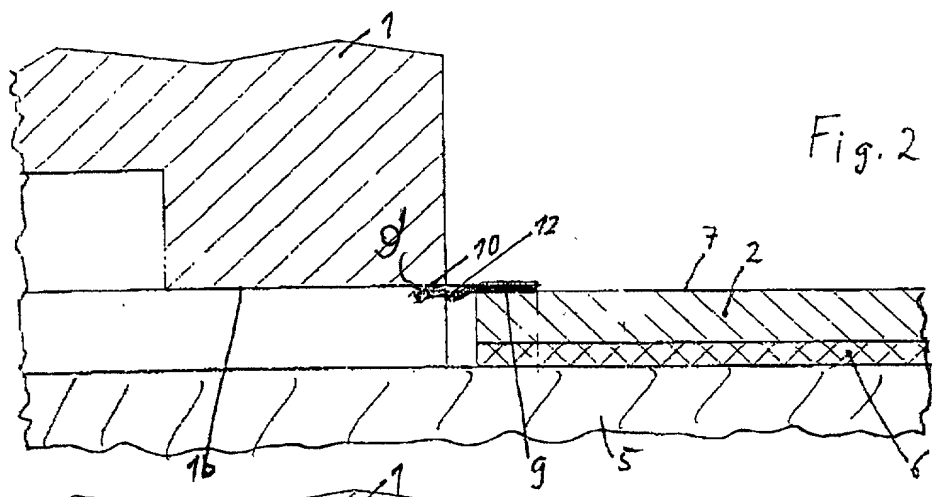
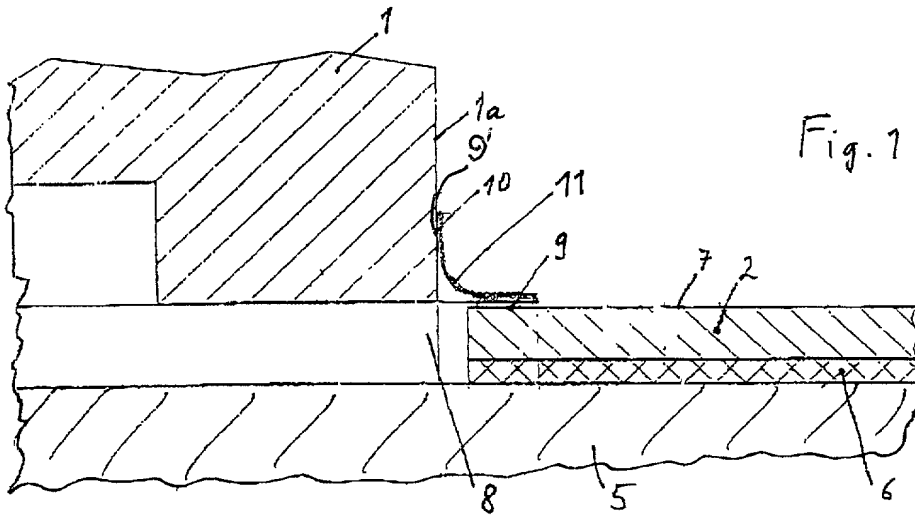
1 7. The circuit device as defined in claim 1, further comprising a conductor strip  
2 substrate (2) and wherein said conductor strip (7) is mounted on said conductor  
3 strip substrate (2).

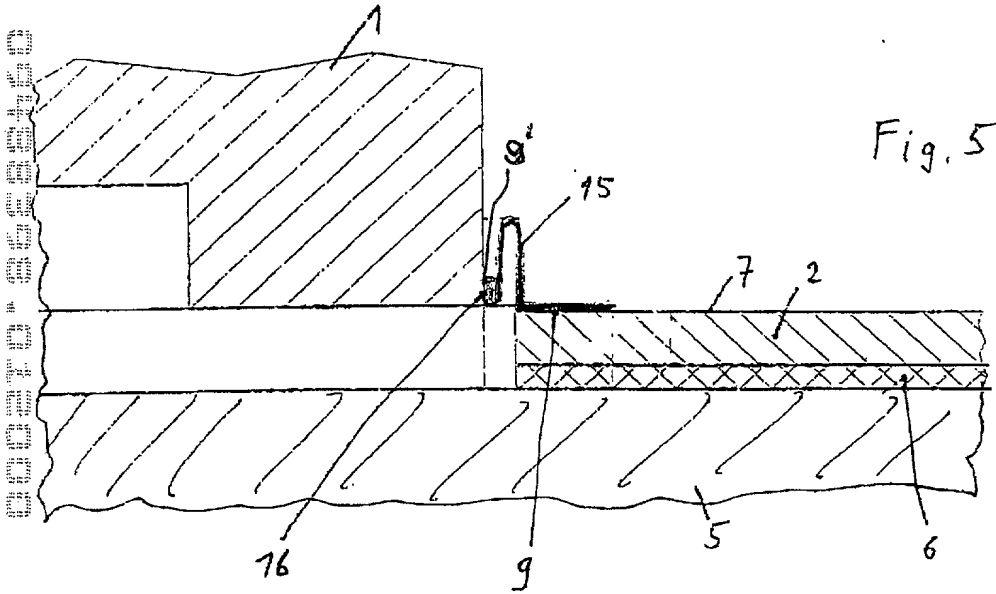
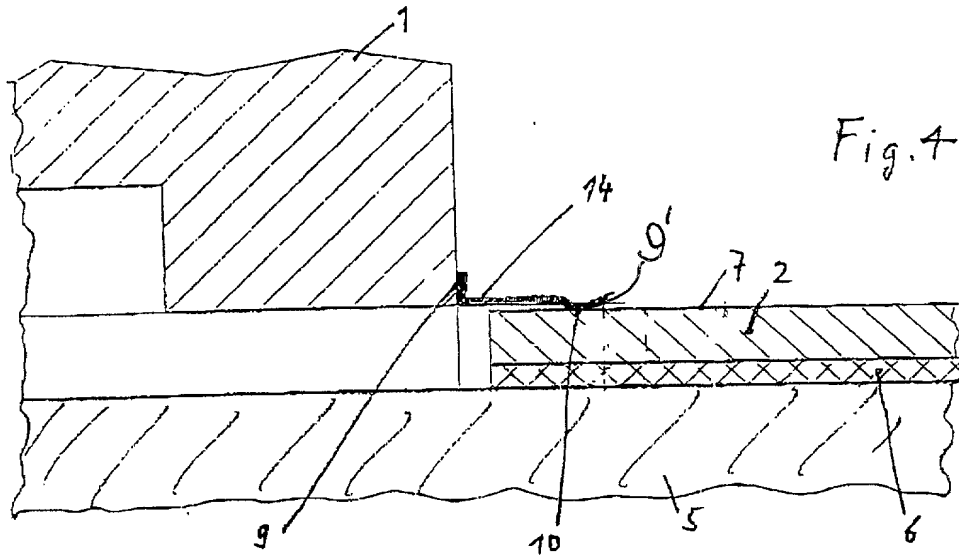
1 8. The circuit device as defined in claim 1, wherein both surfaces (1a,7) of the  
2 wave guide (1) and the conductor strip (7) contacting the contact element are  
3 substantially perpendicular to each other.

1 9. The circuit device as defined in claim 1, wherein both surfaces (1a,7) of the  
2 wave guide (1) and the conductor strip (7) contacting the contact element are  
3 substantially parallel to each other.

## ABSTRACT OF THE DISCLOSURE

The circuit device has a contact element which electrically connects a wave guide (1) with a conductor strip (2) by means of two contacting areas. To avoid mechanical stresses due to thermal expansion the contact element is formed as a precisely prefabricated coil spring having reproducible properties, which is connected at one of the contacting areas to the wave guide (1) or the conductor strip (2) by means of an electrically conducting adhesive or glue, while the second contacting area is provided as a sliding contact, whereby the coil spring is pre-stressed.





# Declaration and Power of Attorney for Patent Application Erklärung für Patentanmeldungen mit Vollmacht

## German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides  
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Juergen SEIZ  
Heinz EISENSCHMID  
Andreas KUGLER  
Achim DIETERICH

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aufgeführten Angaben entsprechen, dass ich nach bestem Wissen der  
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Informationen an, die zur Prüfung der Patentfähigkeit in Einklang  
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As a below named inventor, I hereby declare that:

Bernhard LUCAS  
Frank SCHATZ  
Juergen SEIZ  
Heinz EISENSCHMID  
Andreas KUGLER  
Achim DIETERICH

My residence, post office address and citizenship are as stated next  
to my name.

I believe I am the original, first and sole inventor (if only one name  
is listed below) or an original, first and joint inventor (if plural  
names are listed below) of the subject matter which is claimed and  
for which a patent is sought on the invention entitled

### CIRCUIT DEVICE WITH A CONTACT ELEMENT FOR ELECTRICALLY CONNECTING A WAVE GUIDE AND A CONDUCTOR STRIP IN A NEARLY STRESS-FREE MANNER

the specification of which is attached hereto unless the following box  
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- ☐ was filed on \_\_\_\_\_  
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International Application Number  
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I hereby state that I have reviewed and understand the contents of the  
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I acknowledge the duty to disclose information which is material to  
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## German Language Declaration

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Prior Foreign Applications  
(Frühere ausländische Anmeldungen)

1 99 02 240.2 GERMANY  
(Number) (Country)  
(Nummer) (Land)

(Number) (Country)  
(Nummer) (Land)

Ich beanspruche hiermit Prioritätsvorteile unter Title 35, US-Code, § 119(e) aller US-Hilfsanmeldungen wie unten aufgezählt.

(Application No.) (Filing Date)  
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JANUARY 21, 1999 ☐

(Day/Month/Year Filed)  
(Tag/Monat/Jahr der Anmeldung)

(Day/Month/Year Filed)  
(Tag/Monat/Jahr der Anmeldung)

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Status) (patented, pending, abandoned)  
(Status) (patentiert, schwebend, aufgegeben)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.



## German Language Declaration

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